



# **DESIGNING AN EARTH ELECTRODE FOR DISTRIBUTION SUBSTATIONS**

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## Abstract

In electrical engineering, the term ground or earth has several meanings depending on the specific application areas. Ground is the reference point in an electrical circuit from which other voltages are measured, a common return path for electrical current ( earth return or ground return), or a direct physical connection to the earth.

Electrical circuits may be connected to ground (earth) for several reasons. In a power circuit, a connection to ground is done for safety purposes to protect people from the effects of faulty insulation on electrically powered equipment. A connection to ground helps limit the voltage built up between power circuits and the earth, protecting circuit insulation from damage due to excessive voltage.

There are several types of earthing in the world. They are TT system, TN system and IT system. But in Sri Lanka most common method is the TT system. That means both the consumer and the source end should separately be earthed. Those earth electrodes should have less resistance and non corrosive perfect bonding.

In the power distribution system in Sri Lanka normally the main source is -the CEB transformer. According to the TT system, the. substation should be earthed properly. If not it will affect the consumers by creating neutral leakage current, unbalancing voltage" voltage fluctuations and poor lightning protection etc. As a result transformer can be damaged, customer's electrical equipment and installation can be damaged .Life of humans and animals are in danger as the step and touch voltages have high values.

Generally CEB distribution substation has two earth electrodes: one for neutral and the other for lightning arrestor and the body. According to the CEB rules and IEE regulations the earth resistance of those electrodes should be less than 10 Ohms.



During last 20 years, CEB has used different types of earth electrodes for distribution substations. That is 10 feet long cast iron pipes, 6 feet long GI pipes, 1 m long copper plated steel rod with concrete mesh etc. But according to my investigations most of distribution substations of CEB have the resistance of around 100 Ohms. Hence I decided to select this topic as a project.

Therefore the aim of this project is to design an earth electrode with high performance for distribution substations. This electrode can be used at consumer end too. First, an electrode was designed for a better surface area. The electrode was a combination of a rod and a semi sphere. According to the soil type, the length of the rod can be varied. However to reduce the resistivity of the surrounding soil, a special mixture was prepared with a resistivity of around 4 ohm m and it was used to back fill the electrode. An Aluminum or Galvanized barrel was used to avoid mixing that solution with the soil. As a result, the resistance of the electrode was reduced. I have designed eight types of electrodes for different soil types. However, the electrode-type D, that is 3m rod and a radius of 0.75m barrel can be used at the most of areas since the resistivity is below 650 Ohm m in Sri Lanka. Therefore we can maintain the level of earth resistance below 10 ohms easily.